NEW ENGLAND FERN ALLIES, OPHIOGLOSSACEAE, HYMENOPHYLLACEAE, AND MARSILEACEAE.

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This is the second paper reporting on New England pteridophytes in preparation for a set of computer documented distribution maps. An account of this project is given by A. Tryon (1978). For the most part, information on the taxa has been obtained through an examination of specimens in the Gray Herbarium (GH) and the New England Botanical Club Herbarium (NEBC). In a few cases, I have relied on recent monographs for the inclusion of the rarer taxa.

EQUISETACEAE

Equisetum

Much of the infraspecific variation in *Equisetum* species is a result of environmental modification and phenotypic plasticity. This is especially true of *E. arvense,* as shown by Hauke (1966). The numerous forms and varieties included by Fernald (1950) are therefore excluded from this list since they are not of systematic importance. The taxa listed are those accepted by Hauke (1963, 1978).

Equisetum arvense L.	Equis arv	Field Horsetail
E. arvense × **E. fluviatile** *E.* × *litorale* Kuehl	Equis arv × fluv	Shore H.
E. fluviatile L.	Equis fluv	Water H.
E. hyemale L. var. **affine** (Engel.) A. A. Eaton	Equis hyem	Common Scouring Rush
E. hyemale × **E. laevigatum** *E.* × *Ferrissii* Clute	Equis hyem × laev	
E. hyemale × **E. variegatum** *E. variegatum* var *Jesupi* A. A. Eaton *E.* × *trachyodon* A. Br.	Equis hyem × vari	
E. palustre L.	Equis palus	Marsh H.
E. pratense Ehrh.	Equis prat	Meadow H.
E. scirpoides Michx.	Equis scirp	Dwarf H.
E. sylvaticum L.	Equis sylv	Wood H.
E. variegatum Schl.	Equis vari	Variegated H.

LYCOPODIACEAE

Lycopodium

In recent years there has been an increasing acceptance of classification systems that recognize several genera for the north temperate lycopods. The data available on sporophyte morphology, spore ornamentation, gametophyte morphology, cytology, and anatomy are suggestive of a polyphyletic origin of the boreal species. However, it is important to remember that relatively little is known about the tropical species where most of the diversity in the genus occurs. Until these tropical species are examined more closely and can be placed within one of these systems (see Tutin et al., 1964), it seems appropriate to agree with other students of the genus (Bruce, 1976a, 1976b; Øllgaard, 1975, 1979; Boivin, 1950; Wilce, 1972) who continue to recognize a single genus *Lycopodium*.

Recent works by Wilce (1965), Hickey (1977) and Beitel (1979) have clarified some of the difficult species groups in *Lycopodium*. This genus now poses relatively few taxonomic problems in the New England area with the exception of the *L. inundatum* complex. This latter group still needs considerable study before a definitive listing of its taxa can be presented. Of particular interest is the occurrence of *L. carolinianum* in the Connecticut River valley of central Massachusetts. Since this is a coastal plains species, its occurrence only in central Massachusetts rather than on Cape Cod or adjacent islands is quite surprising and it will be interesting to see if this species persists in New England. The nomenclature of Wilce (1965) is followed for *L. complanatum, L. sabinaefolium, L. sitchense,* and *L. tristachyum*. However, *L. flabelliforme* has been replaced by the older name *L. digitatum* (Hickey & Beitel, 1979).

Lycopodium alopecuroides L.	Lyco alop	Foxtail Clubmoss
L. annotinum L.	Lyco annot	Stiff C.
L. carolinianum L.	Lyco caro	Slender C.
L. clavatum L.	Lyco clav	Staghorn C.
L. complanatum	Lyco comp	Northern
×L. digitatum	×digit	Running Pine
L. complanatum	Lyco comp	
× L. tristachyum	× trist	

L. dendroideum *L. obscurum* var. *dendroideum* (Michx.) D. C. Eaton *L. obscurum* forma *dendroideum* (Michx.) Blomq. & Corr.	Lyco dend	Tree C.
L. digitatum A. Br. *L. complanatum* var. *flabelliforme* Fern. *L. flabelliforme* (Fern.) Blanch. *L. complanatum* var. *Dillenianum* Döll	Lyco digit	Running Pine
L. digitatum × **L. tristachyum** *L.* × *Habereri* House	Lyco digit × trist	Haberer's Running Pine
L. inundatum L. var. **inundatum**	Lyco inun var inun	Bog C.
L. inundatum var. **Bigelovii** Tuckerm.	Lyco inun var Bigel	Slender Bog C.
L. inundatum var **robustum** R. J. Eaton	Lyco inun var robus	Robust Bog C.
L. lucidulum Michx.	Lyco luci	Shining C.
L. lucidulum × **L. Selago** *L.* × *Buttersii* Abbe	Lyco luci × Sel	
L. obscurum L. var **obscurum**	Lyco obsc. var obsc	Prince's Pine
L. obscurum L. var. **isophyllum** Hickey	Lyco obsc var isop	Prince's Pine, Tree C.
L. sabinaefolium Willd.	Lyco sabin	Savin Leaved C.
L. Selago L.	Lyco Sel	Fir C.
L. sitchense Rupr. *L. sabinaefolium* var. *sitchense* (Rupr.) Fern.	Lyco sitch	Sitka C.
L. tristachyum Pursh	Lyco trist	Ground Cedar
L. tristachyum × **L. alpinum** *L.*×*Issleri* (Rouy) Lawal.	Lyco trist × alp	

SELAGINELLACEAE

Selaginella

Selaginella is the only genus of fern allies in New England that does not present problems in identification. All three of the New England species are morphologically distinct and ecologically or geographically separated.

Selaginella apoda (L.) Fern.	Selag apod	Meadow Spikemoss
S. rupestris (L.) Spring	Selag rupes	Rock S.
S. selaginoides (L.) Link	Selag selag	Northern S.

ISOETACEAE

Isöetes

Until a modern treatment for the New England species of *Isöetes* is proposed no listing of taxa can be considered definitive. The discrepancies between the works of Braun (1847), Engelmann (1882), Eaton (1900), Pfeiffer (1922), Proctor (1949) and Reed (1953, 1965) have led to confusion in the understanding of species limits and relationships in the New England members of this taxonomically difficult genus. For this report, six species groups have been recognized which, for the sake of simplicity, have been treated as species. These six taxa are readily distinguished by megaspore and leaf characters. It should be stressed however, that some of these taxa, especially *I. muricata* and *I. riparia*, are quite heterogenous while others, such as *I. Eatoni,* may represent local aberrant forms or hybrids. The early work of Eaton (1900) still stands as the most complete and discerning work on the New England taxa.

Isoetes Eatoni Dodge *I. Gravesii* Eaton	Isoet Eaton	Eaton's Quillwort
I. Engelmannii A. Br. *I. foveolata* A. A. Eaton	Isoet Engel	Engelmann's Q.
I. macrospora Dur.	Isoet macro	Large-spored Q.
I. muricata Dur. *I. echinospora* var *Braunii* (Dur.) Engel. *I. echinospora* var. *muricata* (Dur.) Engel.	Isoet muri	Spiny-spored Q.

I. riparia Engel. *I. Dodgei* A. A. Eaton *I. echinospora* var *robusta* Engel. *I. saccharata* var. *Amesii* A. A. Eaton	Isoet ripar	River Q.
I. Tuckermanii A. Br.	Isoet Tuck	Tuckerman's Q.

OPHIOGLOSSACEAE

Botrychium

Botrychium is a taxonomically perplexing group because the species are morphologically simple, have a great deal of phenotypic plasticity and, for the most part, lack habitat specificity. Clausen's (1938) monograph of the Ophioglossaceae has outlined the various morphological entities involved, but additional field work and biosystematic studies are needed before a wholly adequate systematic treatment can be completed. The work on *B. minganense* by Wagner & Lord (1956) shows that this species is morphologically and cytologically distinct from *B. Lunaria. Botrychium minganense* is a tetraploid with 2n = 180 and *B. Lunaria* is diploid with 2n = 90. The report by Stevenson (1975) of two leaf types, each representing different taxa, attached to a single stem of *B. multifidum* points out the extensive morphological variability of *Botrychium* species. While *B. oneidense* may ultimately be accepted, the available evidence on its status is inconclusive (Clausen, 1944; Wagner, 1960, 1961a, 1961b).

Botrychium dissectum Spreng. *B. obliquum* Muhl. *B. oneidense* (Gilb.) House *B. dissectum* forma *oneidense* (Gilb.) Clute *B. multifidum* var. *oneidense* (Gilb.) Farwell	Botr diss	Cut-leaved Grape Fern
B. lanceolatum (Gmel.) Angstr.	Botr lance	Triangle G. F.
B. Lunaria (L.) Sw.	Botr Lunar	Moonwort
B. matricariifolium A. Br.	Botr matri	Matricary G. F.

B. minganense Vict.	Botr ming	Mingan Moonwort
B. Lunaria var *minganense* (Vict.) Dole		
B. Lunaria forma *minganense* (Vict.) Clute		
B. multifidum (Gmel.) Rupr.	Botr multi	Leathery G. F.
B. multifidum var. *intermedium* (D. C. Eaton) Farwell		
B. multifidum forma *dentatum* Tryon		
B. simplex Hitch.	Botr simp	Least G. F.
B. virginianum (L.) sw.	Botr virg	Rattlesnake Fern

Ophioglossum

In New England there is a single taxon of the genus *Ophioglossum*. While this is a member of the *O. vulgatum* complex, its status with respect to other members has yet to be critically assessed. In view of the differences between it and other North American members of the complex (Wagner, 1971) it seems appropriate to continue to recognize it as a variety.

Ophioglossum vulgatum L.	Ophio vulg	Adder's Tongue Fern
var. **pseudopodum** (Blake) Farwell		

HYMENOPHYLLACEAE

Trichomanes

The recent discovery (McAlpin & Farrar, 1978) of an independently reproducing *Trichomanes* gametophyte at Mt. Toby in Franklin Co., Massachusetts adds a new family to the New England flora. Since sporophytes are not produced, identification to species cannot be made for this plant. It is expected that additional locations of this gametophyte will be found when similar environments are searched.

Trichomanes sp.	Trich	Appalachian Gametophyte

MARSILEACEAE

Marsilea

Marsilea quadrifolia, the only New England member of the Marsileaceae, is a naturalized introduction. It was first collected in 1860 from a pond in Litchfield, Connecticut but has since been reported from numerous other stations throughout southern New England. While some of these newer stations are obvious transplants, others appear to represent natural migrations, perhaps via vegetative reproduction. *Marsilea's* persistence and spread outside of cultivation indicates that it has become naturalized and can therefore be considered a part of the flora of New England.

Marsilea quadrifolia L. Mars quad Water Clover

EXCLUDED SPECIES

SALVINIACEAE

Azolla

In the Gray Herbarium and the New England Botanical Club Herbarium there are numerous New England collections of *Azolla caroliniana*. All of these specimens were collected between 1894 and 1902 and all apparently originated from a Lotus pond in Springfield, Massachusetts. While *Azolla caroliniana* has been included in the aquatic flora of New England by Fassett (1940), Svenson (1944) and Muenscher (1944) the collecting record of this plant indicates that it is not and never has been naturalized in New England.

Salvinia

A single collection of *Salvinia rotundifolia* from Norfolk Co., Massachusetts, made in 1941, is in the New England Botanical Club Herbarium. As there appear to be no previous or subsequent collections of this plant from New England, this record apparently represents an ephemeral escape from cultivation and the species is therefore excluded from this list.

LITERATURE CITED

BEITEL, J. M. 1979. The clubmosses *Lycopodium sitchense* and *L. sabinifolium* in the upper Great Lakes region. Mich. Bot. **18:** 3–13.

BOIVIN, B. 1950. The problems of generic segregates in the form-genus *Lycopodium*. Amer. Fern J. **40:** 32–41.

BRAUN, A. 1847. On the North American species of *Isoetes* and *Marsilea*. J. Arts & Sci., n.s. **3:** 52–56.

BRUCE, J. G. 1976a. Development and distribution of mucilage canals in *Lycopodium*. Amer. J. Bot. **63:** 481–491.

_____. 1976b. Gametophytes and subgeneric concepts in *Lycopodium*. Amer. J. Bot. **63:** 919–924.

CLAUSEN, R. T. 1938. A monograph of the Ophioglossaceae. Mem. Torrey Bot. Club **19:** 1–171.

_____. 1944. On the status of *Botrychium dissectum* var. *oneidense*. Amer. Fern J. **34:** 55–60.

EATON, A. A. 1900. The genus *Isoetes* in New England. Fernwort Papers **2:** 1–16.

ENGELMANN, G. 1882. The genus *Isoetes* in North America. Trans. St. Louis Acad. Sci. **4:** 358–390.

FASSETT, N. C. 1940. A manual of Aquatic Plants. McGraw-Hill Book Co., New York.

FERNALD, M. L. 1950. Gray's Manual of Botany. 8th ed. American Book Co., New York.

HAUKE, R. L. 1963. A taxonomic monograph of the genus *Equisetum* subgenus *Hippochaete*. Beih. Nova Hedwigia **8:** 1–123.

_____. 1966. A systematic study of *Equisetum arvense*. Nova Hedwigia **13:** 81–109.

_____. 1978. A taxonomic monograph of *Equisetum* subgenus *Equisetum*. Nova Hedwigia **30:** 385–455.

HICKEY, R. J. 1977. The *Lycopodium obscurum* complex in North America. Amer. Fern J. **67:** 45–48.

HICKEY, R. J. & J. M. BEITEL. 1979. A name change for *Lycopodium flabelliforme*. Rhodora **81:** 137–140.

MCALPIN, B. & D. R. FARRAR. 1978. *Trichomanes* gametophytes in Massachusetts. Amer. Fern J. **68:** 97–98.

MUENSCHER, W. C. 1944. Aquatic Plants of the United States. Cornell University Press. Ithaca, New York.

ØLLGAARD, B. 1975. Studies in the Lycopodiaceae, I. Observations on the structure of the sporangium wall. Amer. Fern J. **65:** 19–27.

_____. 1979. Studies in the Lycopodiaceae, II. The branching patterns and infrageneric groups of *Lycopodium* sensu lato. Amer. Fern J. **69:** 49–61.

PFEIFFER, N. E. 1922. Monograph of the Isoetaceae. Ann. Mo. Bot. Gard. **9:** 79–232.

PROCTOR, G. R. 1949. *Isoetes riparia* and its variants. Amer. Fern J. **39:** 110–121.

REED, C. F. 1953. Index Isoetales. Bol. Soc. Brot. **27:** 5–72.

_____. 1965. *Isoetes* in Southeastern United States. Phytologia **12:** 369–400.

STEVENSON, D. WM. 1975. Taxonomic and morphological observations on *Botrychium multifidum* (Ophioglossaceae). Madroño **23:** 198–204.

SVENSON, H. K. 1944. The new world species of *Azolla*. Amer. Fern J. **34:** 69–84.

TRYON, A. F. 1978. The New England Ferns (Filicales). Rhodora **80:** 558–569.

TUTIN et al., eds. 1964. Flora Europaea, **I.** Lycopodiaceae to Platanaceae. University Press. Cambridge, England.

WAGNER, W. H., JR. 1960. Periodicity and pigmentation in *Botrychium* subg. *Scepteridium* in the northeastern United States. Bull. Torrey Bot. Club **87:** 303–325.

_____. 1961a. Roots and the taxonomic differences between *Botrychium oneidense* and *B. dissectum*. Rhodora **63:** 164–175.

_____. 1961b. On the relative development of the fertile segments in *Botrychium dissectum* and *B. oneidense*. Amer. Fern J. **51:** 75–81.

_____. 1971. The Southeastern Adder's-tongue, *Ophioglossum vulgatum* var. *pycnostichum*, found for the first time in Michigan. Mich. Bot. **10:** 67–74.

WAGNER, W. H., JR. & L. P. LORD. 1956. The morphological and cytological distinctness of *Botrychium minganense* and *B. lunaria* in Michigan. Bull. Torrey Bot Club. 83: 261–280.

WILCE, J. H. 1965. Section Complanata of the genus *Lycopodium*. Beih. Nova Hedwigia 19: 1–233.

_____. 1972. Lycopod spores, I. General spore patterns and the generic segregates of *Lycopodium*. Amer. Fern **J.** 62: 65–79.

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